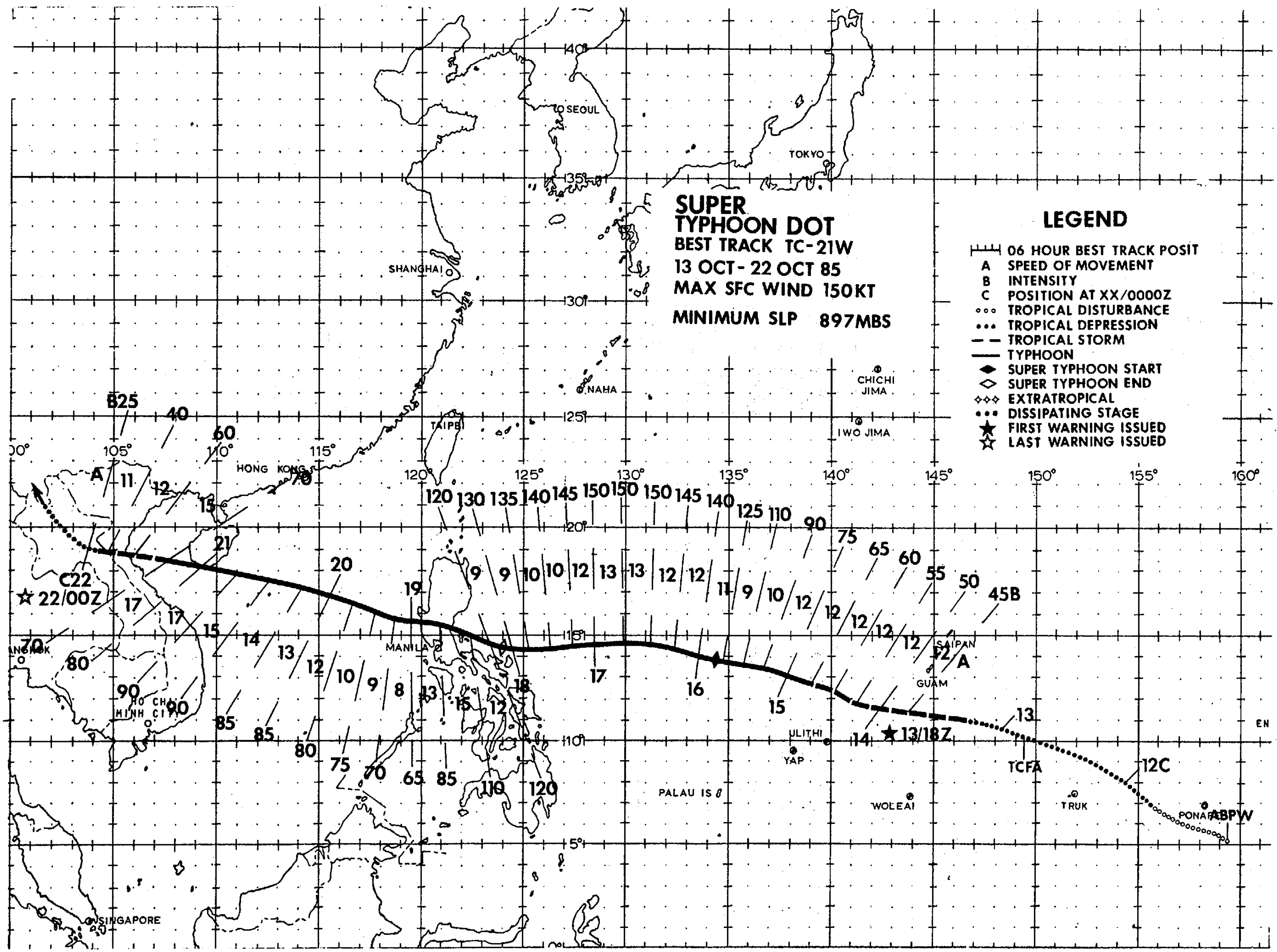
SUPER TYPHOON DOT
BEST TRACK TC-21W
13 OCT - 22 OCT 85
MAX SFC WIND 150KT
MINIMUM SLP 897MBS
LEGEND
06 HOUR BEST TRACK POSIT
A SPEED OF MOVEMENT
B INTENSITY
C POSITION AT XX/0000Z
TROPICAL DISTURBANCE
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
SUPER TYPHOON START
SUPER TYPHOON END
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
SEOUL
TOKYO
SHANGHAI
NAHA
CHICHI JIMA
IWO JIMA
TAIPEI
HONG KONG
MANILA
SAIPAN
GUAM
ULITHI
YAP
PALAU IS
WOLEAI
TRUK
PONAPE
HO CHI MINH CITY
SINGAPORE
TCFA
ABPW
★13/18Z
☆22/00Z

After Typhoon Brenda, which had developed in the low-level southwest monsoon trough, completed extra-tropical transition on the 5th of October, the mid-level subtropical ridge became well-established over the Northwest Pacific. This synoptic feature would confine the development of tropical cyclones to low latitudes near 10N in the near-equatorial trough. Also coincident with Brenda's movement to the north was the replacement of the low-level southwest monsoon flow over the South China Sea with north-to-northeasterly flow off of the Asian continent.

Typhoon Dot was the only super typhoon (intensity equal to or greater than 130 kt (67 m/s)) of the 1985 WESTPAC season. It intensified (deepened) explosively causing intensity forecast difficulties. Other distinguishing characteristics were the small size of the area of intense convection, the small radius of maximum wind, and the absence of low-level southwest monsoon inflow. Also of interest was the large wind radius in the northwest semicircle (when it was located southeast of Luzon) where surface winds were enhanced by a strong pressure gradient between the tropical cyclone and a polar high pressure cell located near 40N 110E.

Dot was first detected as a tropical disturbance in the near-equatorial trough, 150 nm (278 km) southeast of Ponape (WMO 91348) on the 11th of October. Figure 3-21-1 shows the disturbance on the 12th of October exhibiting signs of organization in its upper-level outflow. The system moved west-northwest and reached tropical storm intensity on the 13th south of Guam.

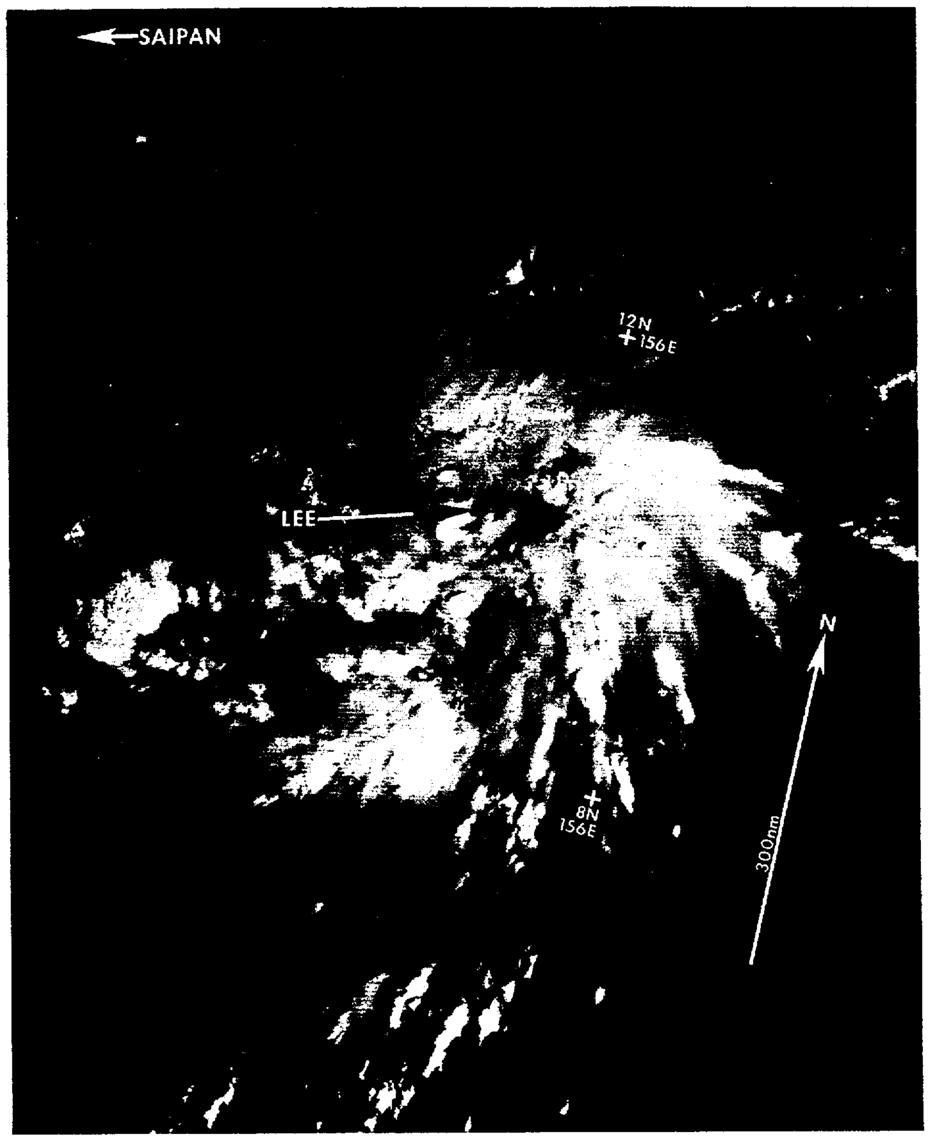

Figure 3-21-1. Super Typhoon Dot as a disturbance in the near-equatorial trough with signs of organized upper-level outflow (120006Z October DMSP visual imagery).

The track forecasts for Typhoon Dot did not present any significant difficulty for the forecasters at JTWC. Figure 3-21-2 shows that the mid-level easterlies dominate the Trust Territories westward through the Philippine Islands and into Southeast Asia at 120000Z. With no change expected in the orientation or strength of the ridge, a west-northwest track at 10 to 20 kt (19 to 37 km/hr) under this ridge was considered to be the best forecast. This was in agreement with climatological and analog forecast guidance. The two numerical models, OTCM (One-way interactive Tropical Cyclone Model) and NTCM (Nested Tropical Cyclone Model), were of little help during the crucial first four days of forecasts (when Dot was approaching the Philippines). Due to computer problems at Fleet Numerical Oceanography Center (FNOC) the older Primitive Equation (PE) model was run in place of the Navy Operational Global Atmospheric Prediction System (NOGAPS). Later, it was determined that OTCM, when running with data from the PE model, didn't have access to the necessary data fields. Subsequently, OTCM was modified to accept the needed data.

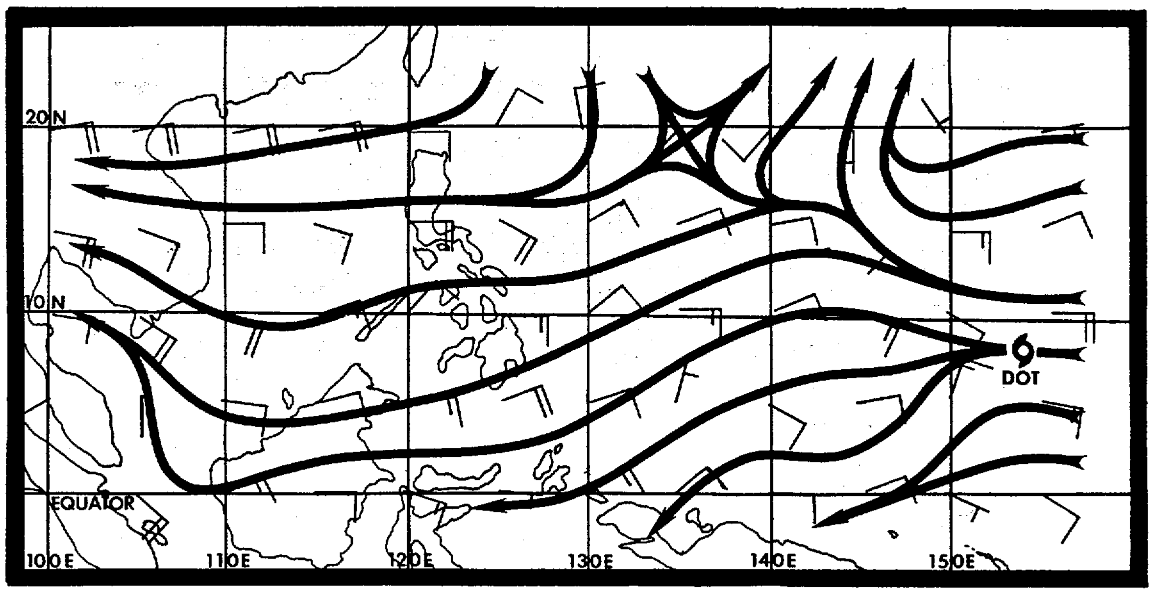

Figure 3-21-2. 400 mb Numerical Variational Analysis (NVA) at 120000Z October showing easterlies over Dot's future track to the west-northwest.

The one aspect of Typhoon Dot that did present considerable forecast difficulty was intensity. In the twenty-three hour period between 150022Z and 152342Z Dot's central sea-level pressure dropped from 969 mb to 903 mb (a decrease of 66 mb). This translates to a drop of approximately 2.8 mb/hour. This meets and exceeds the rate of 2.5 mb/hr (sustained for at least 12 hours) that Holliday and Thompson (1979) used to define explosive intensification (deepening). JTWC uses a technique (Dunnavan, 1981), in which the 700 mb equivalent potential temperature (Theta-E, a measure of the tropical cyclone's thermodynamic energy based on the central 700 mb temperature and dewpoint) and the central sea-level pressure are compared pressure to forecast explosive intensification. The technique calls for intensification to below 925 mb (how far below can be estimated from the technique also) whenever the plots of central sea-level pressure and Theta-E intersect near the critical values of 950 mb and 360 degrees Kelvin (both values being statistical means derived from past intense storms). Figure 3-21-3 is a plot of Dot's central sea-level pressure and Theta-E during the period 140530Z to 180828Z. At Point A (142130Z), the two lines show a tendency to intersect (notice extrapolation to Point A'). However, Point B (150022Z) reflects a decrease in Theta-E. Then, at Point C (150615Z), this trend reverses and again extrapolation to Point C' would indicate intersection. Point D (150853Z) shows a slight

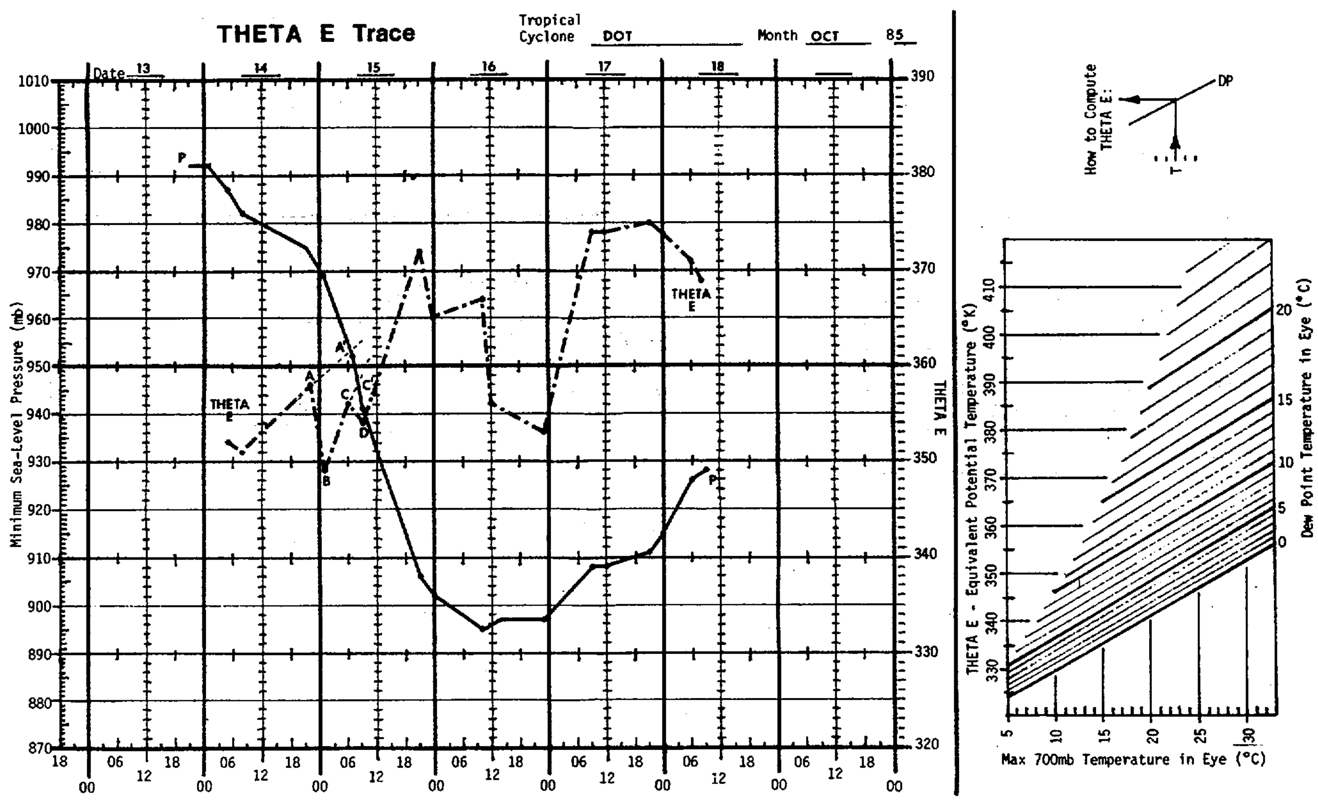

Figure 3-21-3. Plot of Dot's central sea-level pressure and central 700 MB equivalent potential temperature during the period 140530Z to 180828Z October.

decrease in Theta-E and no intersection. The next available aircraft reconnaissance data was not received until 152102Z, and by that time Dot's central sea-level pressure had plummeted to 906 mb and the central 700 mb temperature had soared from 20 Celsius to 30 Celsius (yielding a Theta-E of 372 K when paired with the dewpoint temperature of 11 Celsius). This forecast method is a reliable one in most instances. However, Typhoon Dot demonstrates a situation when the lack of timely aircraft data prevented the effective use of the technique. In post-analysis, if pressure, temperature, and dewpoint data had been available around 151200Z it is a distinct possibility that the intersection of the central sea-level pressure line and the Theta-E line would have been observed.

The reliability of this forecast technique was mentioned earlier. However, in addition to the timing problem already mentioned, a couple of factors should be pointed out. First, the computation of Theta-E is very sensitive to dewpoint temperature (and to a lesser degree ambient temperature). The dewpoint measurement is also sensitive to a sometimes non-homogeneous distribution of moisture in the storm's center. Second, a rarer but sometimes complicating factor is the complexity and delicacy of the dewpoint hygrometer which is an alternately cooled/heated mirror coupled with a thermistor. The dewpoint temperature is recorded when a thin film of dew forms on the mirror. Malfunctions of the instrument occasionally occur.

To give the reader an indication of what impact not knowing that Dot was going to explosively deepen had on the intensity forecasts can be seen in Figure 3-21-4. The graph depicts the best track intensities (at six hour intervals) for the period 131800Z to 181200Z compared to the corresponding 12-,24-,48-, and 72-hour intensity forecasts. Twelve-hour fore-

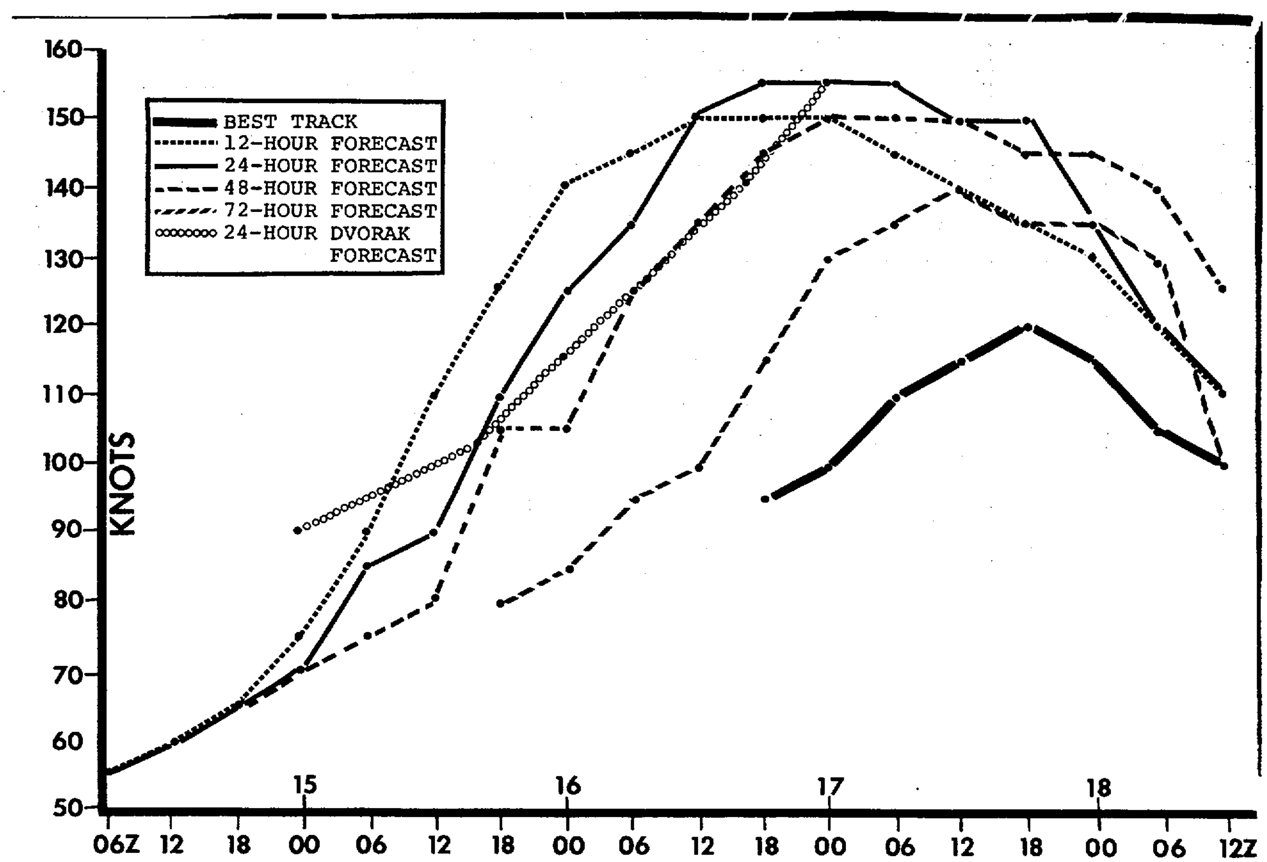

Figure 3-21-4. Plot of Dot's best track intensities at six-hour intervals and corresponding 12-,24-,48-, and 72-hour forecast intensities for the period 131800Z to 181200Z October 85.

casts for the period 151200Z through 160600Z were 20, 15, 15, and 10 kt (10, 8, 8, and 5 m/s) low. For the same period twenty-four hour forecasts were 30, 20, 35, and 20 kt (15, 10, 18, and 10 m/s) below the best track intensities. From the graph one can see that the 24-hour forecast intensity curve is very close to the Dvorak forecast intensity curve. This is usually the case since the Dvorak model is the main JTWC 24-hour intensity forecast tool. The problem with explosive intensification really starts showing up at the 48-hour forecast period. The 48-hour intensity forecasts during the period 151800Z through 161800Z October were 45, 55, 50, 50, and 35 kt (23, 28, 26, 26, and 18 m/s) too low. The three 72-hour forecasts that were effected by the explosive deepening were for the period 161800Z through 170600Z Oct and were 55, 50, and 35 kt (28, 26, and 18 m/s) too low. After Dot had explosively deepened, the intensity forecasts reflected the storm's high initial intensity and the forecast errors decreased significantly with the average 12-hour intensity forecast error for the period 140600Z through 181200Z (18 cases) being 5 kt (3 m/s), the average 24-hour error for the period 141800Z through 181200Z (16 cases) being 14 kt (7 m/s), the average 48-hour error for the period 151800Z through 181200Z (12 cases) being 24 kt (12 m/s), and the average 72-hour error for the period 161800Z through 181200Z (8 cases) being 28 kt (14 m/s). The point being made is that a forecaster doesn't necessarily have to know 72 hours ahead of time that a system is going to explosively deepen, but if he knows 12 or 24 hours ahead of time then the longer range forecasts made during that period will reflect the higher storm intensity and be more accurate.

Figure 3-21-5 shows Super Typhoon Dot at maximum intensity with a well-defined eye and intense convection confined to a small area around the system. Aircraft reconnaissance on the 16th and 17th of

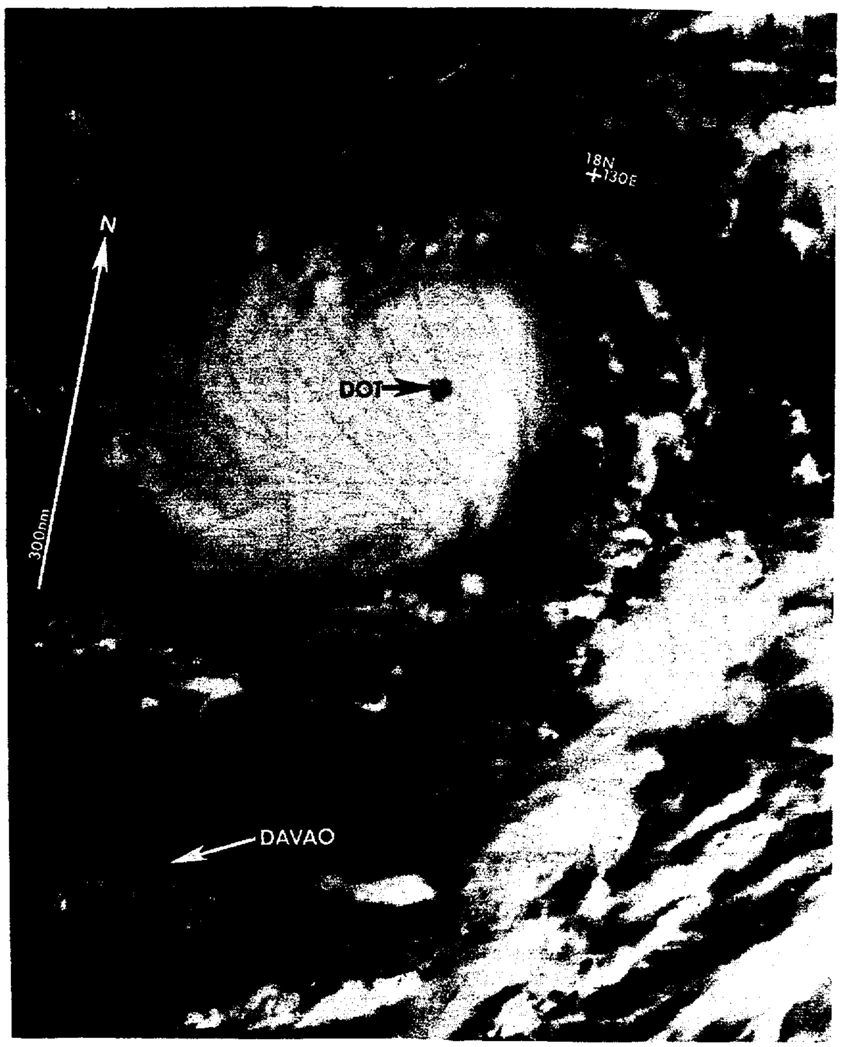

Figure 3-21-5. Super Typhoon Dot at maximum intensity with a well-defined eye and small surrounding ring of intense convection (170147Z October DMSP visual imagery).

October consistently located the maximum surface winds 5 to 10 nm (3 to 5 km) from the center and radar eye diameters of 10 to 15 nm (5 to 8 km).

Figure 3-21-6 shows the surface wind circulation pattern around Dot (while it was southeast of Luzon) at 181200Z October. Strong winds extended out much further in the northwest semicircle where the surface winds were from the north to northeast. This increased flow resulted from a strong pressure gradient that existed between Dot and a polar high-pressure cell located near 40N 110E. The figure also shows the absence of any enhanced low-level southwest monsoon flow over the South China Sea.

The threat posed by Super Typhoon Dot caused all U.S. military installations in the Philippines to be placed in Tropical Cyclone Condition of Readiness I and resulted in the evacuation of aircraft from Cubi Point NAS and Clark AB, and the movement of several ships from Subic Bay. Seventy-four peoples were reported killed, more than 50,000 left homeless, and damage to buildings and crops estimated at 1.3 million dollars. NAVOCEANCOMFAC Cubi Point reported a peak gust of 19 kt (10 m/s) and Det 5, 20WS at Clark AB reported maximum sustained winds of 27 kt (14 m/s) with a peak gust of 44 knots (23 m/s). Dot was a very intense typhoon but the damage done in the Philippines was certainly limited by the storm's small diameter of maximum wind, its small area of intense convection, its path of approach to Luzon (this kept most of the low-level flow parallel to the mountainous terrain, reducing orographically-enhanced rainfall), and the absence of enhanced low-level southwest monsoon flow.

After entering the South China Sea late on the 18th of October with minimal typhoon intensity, Dot began regaining organization overwater and continued on a west-northwesterly track. By 201200Z, the Typhoon's intensity peaked at 90 kt (46 m/s) 300 nm (556 km) south-southwest of Hong Kong (WMO 45007). Dot weakened as it churned across the southern tip of Hainan Island, leaving at least two dead, 2300 houses collapsed, and flooding in its wake. Crossing the Gulf of Tonkin in less than a day, it slammed into the coast of North Vietnam 130 nm (241 km) south of Hanoi (WMO 48819). The final warning on Dot was issued at 220000Z as the system dissipated over the rugged mountains inland.

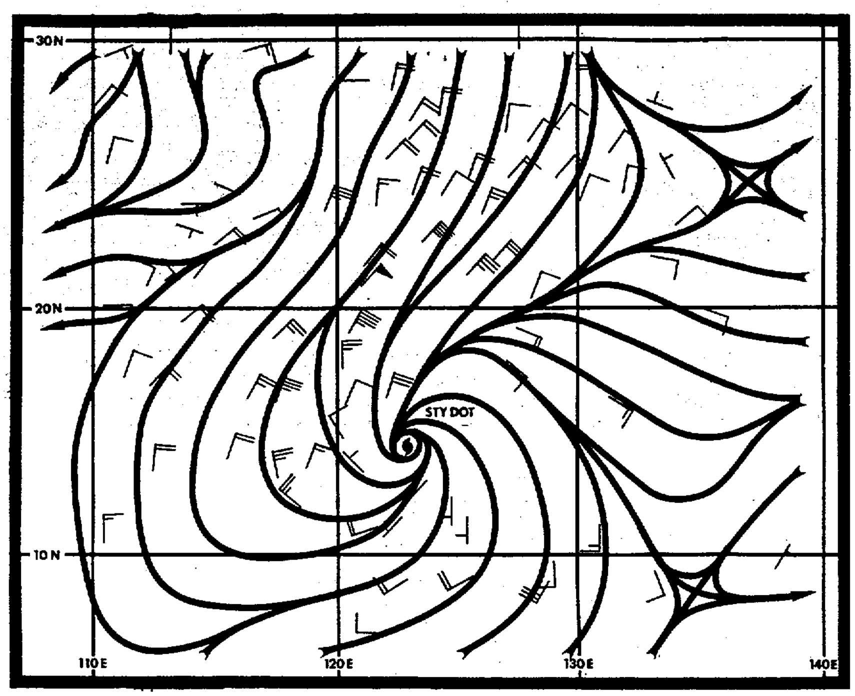

Figure 3-21-6. Surface analysis at 181200Z October showing strong winds extending out a great distance in the northwest semicircle and the absence of (convection-enhanced) low-level southwest monsoon flow.

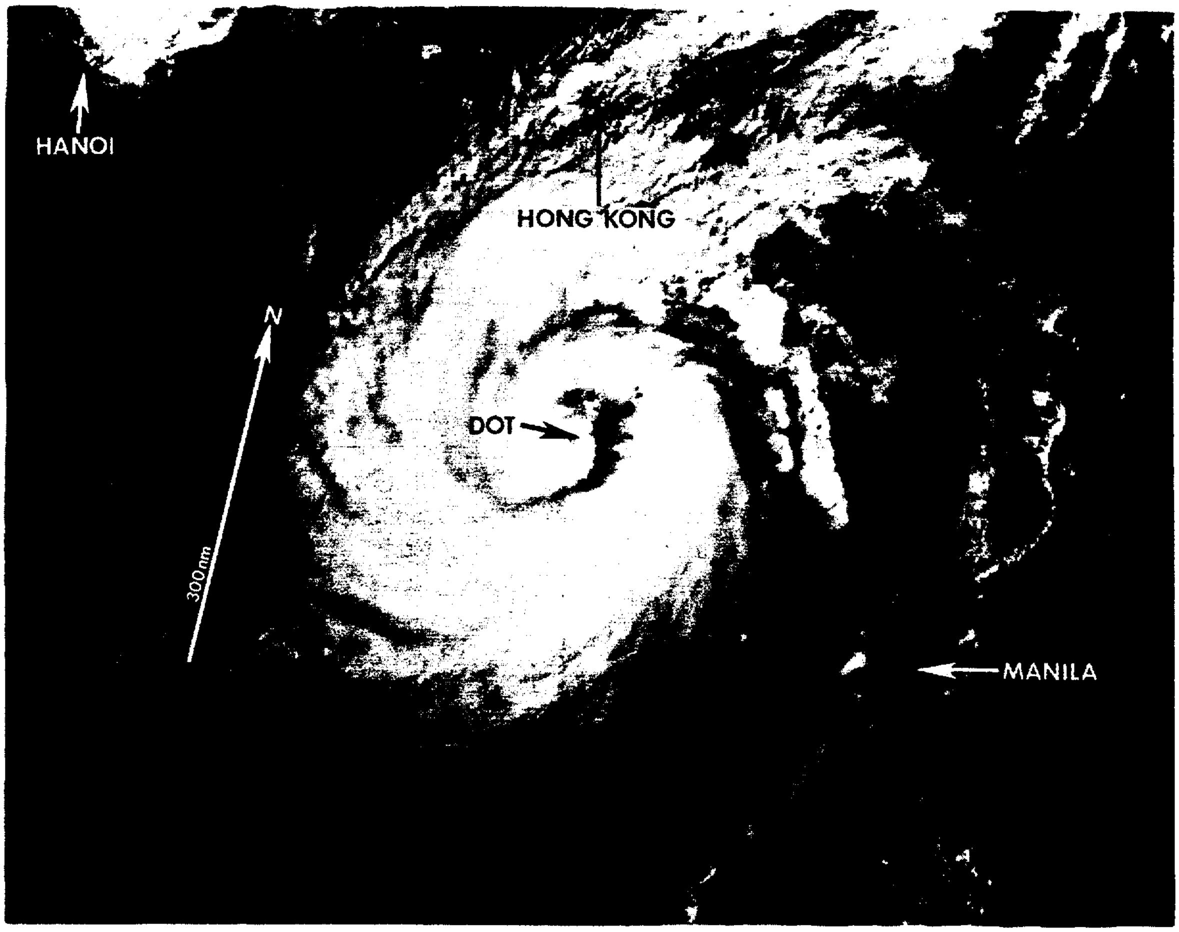

Figure 3-21-7. Super Typhoon Dot with 85 knots (44 m/s) after crossing Luzon and re-intensifying in the South China Sea (200227Z October DMSP visual imagery).